Journal of Psychology

Special Issue “Knowledge Communication”

Supporting and Hindering Knowledge Communication in a Collaborative Picture-Sorting Task

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Abstract

Effective knowledge communication presupposes common ground (Clark & Brennan, 1991) that needs to be established and maintained. This is particularly difficult in remote communication as well as in non-interactive settings, because the speaker cannot use gestures or mimic and has to tailor his utterances to the addressee without receiving feedback. In these situations, the speaker may achieve mutual understanding for example by adopting the addressee's perspective. We present a study conducted to test the impact of instructions that support and hinder individual problem solving and knowledge communication. We used a picture-sorting task requiring individual cognitive processes of feature search (Treisman & Gelade, 1980) in addition to referential communication.

As our study focused on the design of utterances, all participants assumed the role of speaker. Participants were told that their descriptions would be recorded and then listened to later on by a participant in the role of addressee. Eight sets of pictures were used, which varied on two dimensions: the individual cognitive demands of detecting the relevant features (varied as between-subject factor) and the communicative demands (varied as within-subject factor). A further between-subject factor was the type of instructions: The participants received either a collaboration script as supporting instructions, or time pressure was applied to induce stress, or else they were given no additional instructions (control group). We used the speakers' verbal utterances to examine the quality of the speakers' descriptions. For both dimensions of difficulty, we found the expected effects. In the conditions with a collaboration script, there were fewer irrelevant features mentioned and fewer features were described with delay. In the conditions with time pressure, there were fewer irrelevant features described, but the number of correctly described pictures was impaired through the fact that relevant features were also neglected. Under time pressure, speakers tended to provide ambiguous descriptions regarding the frame of reference.

Supporting and Hindering Knowledge Communication in a Collaborative Picture-Sorting Task

Effective knowledge communication is an important part of collaboration. It is crucial, for example, in collaborative tasks with unshared knowledge (e.g. hidden-profile tasks, see Möhle & Diehl and Piontkowski in this issue; or expert-layperson communication, see Jucks, Schulte-Löbbert & Bromme in this issue), as well as in “mentoring” collaborative tasks, in which one person receives instructions from another. In such settings, people have to face not only task-specific cognitive demands but also communicative demands: Knowledge communication presupposes common ground (e.g. Clark & Brennan, 1991) that needs to be established and maintained. Notably, this is particularly difficult in remote communication as well as in non-interactive or asynchronous settings (Clark & Brennan, 1991; Kraut, Fussell, & Siegel, 2003). In remote communication, grounding is hampered due to the lack of physical copresence (Clark & Marshall, 1981): For example, the persons communicating cannot use pointing gestures or gazes to specify an object they are referring to. Moreover, speakers in non-interactive or asynchronous communication have to design their utterances very carefully: The addressees must be able to understand the speaker’s utterances at once – without asking clarification questions. The speaker may achieve this for example by adopting the addressee’s perspective.

Some situations may carry additional difficulties such as time pressure. In such cases, collaboration possibly will be *hindered* as the cognitive and communicative demands are likely to increase (Horton & Keysar, 1996).

Collaboration may be *supported* by structuring the interaction process (e.g. O'Donnell, 1999) or by providing instructions to the collaborators (Hansen & Spada, 2006; Rummel & Spada, 2005).

Supporting and Hindering Collaboration

Support Through Scripts

Several approaches have been used to foster collaboration by structuring the communication process. Scripted cooperation (O'Donnell & Dansereau, 1992) is a prominent technique that was originally developed to trigger cognitive and meta-cognitive activities in dyadic collaborative learning. As this method was indeed found to enhance collaborative learning (see O'Donnell, 1999), it has also been transferred to computer settings (e.g. Baker & Lund, 1997; Hron, Hesse, Reinhard, & Picard, 1997) and has been applied beyond contexts of learning (Nückles & Ertelt, 2006; Rummel & Spada, 2005). Although collaboration scripts vary considerably in terms of form and purpose, they do have at least some aspects in common: They help to reduce the demands of coordination between collaborators and aim at optimizing the interaction process by sequencing it into different phases, defining roles, and assigning them to the collaborators (Fischer, Kollar, Mandl, & Haake, 2007). For example, a collaboration script for collaborative problem solving may consist of a sequence of individual and collaborative phases: First, the collaborators have to work on the problem individually before discussing the possible solution steps in a collaborative phase. To reflect the problem-solving process and search for alternative strategies, an additional individual phase may follow before the collaborators reengage into a second collaborative discussion phase.

In most contexts, collaboration scripts were shown to enhance the collaboration process and the result of collaboration. However, if natural interactions or problem-solving processes are disturbed by the script, this may lead to motivational losses and an impaired outcome (e.g. Bruhn, 2000; Dillenbourg, 2002).

Hindrance Through Time Pressure

In many cases, collaboration takes place under suboptimal or hindering conditions. Hindrance or stress, caused for example by time pressure, is likely to increase the demands on the collaborators and to modify the individual cognitive and communicative processes. For example, under stress, people shorten the decision-making process by filtering and processing the relevant information faster (Payne, Bettman, & Johnson, 1988). If the stress is too high, they tend to ignore relevant information for their decision (premature closure; Janis, 1983). Under time pressure, inaccurate judgments are likely to occur because the cognitive control mechanisms that are needed for consistent judgments and problem-solving are impaired (Rothenstein, 1986).

The influence of time pressure on control mechanisms has also been described in research on communication. Horton and Keysar (1996) showed that speakers tend to produce more egocentric utterances under time pressure, because control processes needed to tailor the utterances for a specific audience (audience design) are disturbed.

In this paper, we present a study conducted to test the impact of supporting and hindering instructions on the communication process and collaboration outcome. We used a picture-sorting task with a structure similar to the referential communication task (Krauss & Weinheimer, 1966), which has often been used to study communication. However, our task holds more individual cognitive demands, as systematic visual search processes are required to detect small differences between the pictures. The individual cognitive and communicative demands will be described in more detail after the presentation of the task.

The Picture-Sorting Task

The picture-sorting task used can be categorized as a “general class of ‘mentoring’ collaborative physical tasks” (Kraut et al., 2003, p. 16) in which one person receives instructions from another person about where to place e.g. the pictures or objects and manipulates them according to the instructions. In the setting that we intended to simulate, a speaker and an addressee have to jointly solve a task, but not at the same point in time and without sharing the same physical environment. As our study focused on the design of utterances, all participants assumed the role of speaker. Participants were told that their descriptions would be recorded and then listened to later on by a participant in the role of addressee. The addressee would use the recordings to place the randomly presented pictures in the target order. As our study concentrated on the speaker's role, the descriptions were indeed recorded, but they were not presented to an addressee.

Figure 1 shows one set of pictures as presented to the speakers. Each set consisted of nine target pictures and seven additional ones. The pictures were very similar and differed only in terms of minor details. Therefore, before knowledge communication could take place, the participants first had to search for the differences. This component of feature detection constitutes the main difference from the classical referential communication task, in which the task demand consists mainly in the verbal description of clearly different pictures. This individual cognitive demand makes the task more comparable to realistic collaborative tasks in which knowledge communication often has to occur in addition to individual cognitive processes.

Insert Figure 1 about here

The Task Demands

Cognitive Demands

Before knowledge communication can take place, individual cognitive processes are needed to construct a representation of the pictures and the relevant differences between them. To identify the relevant features that differ between the pictures, a serial visual search (e.g. Treisman & Gelade, 1980) has to occur. This requires the allocation of attention and is a time-consuming and error-prone process because focused attention is only a limited resource and cannot be directed to all details at the same time (Treisman & Schmidt, 1982). When observing a scene or looking at pictures, changes in objects or parts of objects are therefore often not detected – an effect called *change blindness* (e.g. Rensink, O'Regan, & Clark, 1997). This effect was found independently of the occurrence of saccades if attention was not allocated to the changing part of the picture (O'Regan, Deubel, Clark, & Rensink, 2000; Rensink et al., 1997). Such an effect was shown not only for change detection tasks, but also if the participants searched for differences in simultaneously presented pictures (Brunel &

Ninio, 1997; Scott-Brown, Baker, & Orbach, 2000; Shore & Klein, 2000). The visual salience of the differences, such as size, location, or color, was found to influence the detection of change (Smilek, Eastwood, & Merikle, 2000; Williams & Simons, 2000).

Communicative Demands

The communicative demands consist in ensuring mutual understanding between the two collaborators by installing *referential identity* (Clark & Brennan, 1991), i.e. they have to assign the same meaning to a word and to match this word to the same object. Furthermore, in our task, speaker and addressee need a mutual frame of reference with regard to the *spatial orientation* (see for example Figure 2, picture content 4): A spatial description can be either viewer-centered or object-centered (e.g. Levelt, 1989). Depending on the frame of reference, the description “the man is looking to the left” in picture content 4 would mean the opposite.

Normally, mutual understanding can be achieved by grounding, which usually consists of two phases: A presentation phase in which the speaker presents an utterance, and an acceptance phase in which the addressee accepts the utterance, i.e. she provides the speaker with evidence that she believes she understands what the speaker has said (Clark & Brennan, 1991; Clark & Schaefer, 1989; Clark & Wilkes-Gibbs, 1986). In our study, grounding is not possible because the speaker does not receive feedback and cannot be certain of the addressee’s understanding. Therefore, to achieve mutual understanding, the speaker has to carefully design her utterances (Schober, 1993). To avoid misunderstandings, the expressions used must be as explicit as possible. In consequence, the speaker’s descriptions are likely to be longer (Krauss & Weinheimer, 1966; Murfitt & McAllister, 2001), because the speaker cannot use abbreviations or rely on terms used previously (Pickering & Garrod, 2004). If possible, the speaker has to take on the addressee’s perspective for her descriptions. However, this is not an easy undertaking and will probably fall short if additional difficulties such as time pressure arise (Horton & Keysar, 1996).

An additional aspect of the non-interactive setting in our study is the possibility to analyze the individual performance. In normal, interactive settings, it is difficult to separate the individual achievements, as interactions and feedback effects occur. Thus, we used the non-interactive communication setting in order to scrutinize the individual cognitive and communicative performance.

Hypotheses

Our aim was to examine the impact of the supporting and hindering instructions on one part of the knowledge communication process: the quality of the speaker's utterances. In addition, we varied the demands on two dimensions in order to analyze the influences of cognitive and communicative demands.

The study should test the following hypotheses: (1) We predicted that in conditions with supporting instructions (collaboration script), the participants' description would show a higher quality. (2) We expected to find differentiated effects for the participants in the condition with time pressure: Compared to the control condition, they should focus more on relevant features in their description but at the same time forget some relevant ones due to the time pressure. (3) Furthermore, we expected the quality of the description to depend on the amount of cognitive demands (better descriptions with less cognitive demands) (4) as well as on the amount of communicative demands (better descriptions with less communicative demands).

Method

Participants

Forty-eight students (24 male and 24 female) from the University of Freiburg, Germany, participated in the study. The participants had an average age of 24 years (range = 19 to 37 years). All participants were German native speakers and received five Euros for taking part.

Design and Procedure

A 3 x 2 x 2 factor design was implemented with the type of instruction (supporting/ hindering/ control without additional instruction) and the amount of cognitive demands (four sets high/ four sets low) as between-subject factors and the amount of communicative demands (two picture contents high/ two picture contents low) as an additional within-subject factor (see Table 1).

Insert Table 1 about here

Each participant was assigned randomly to one of the six conditions. The conditions were matched in terms of gender and age. Each participant assumed the role of speaker and was placed in front of a table with a microphone to record the descriptions. Participants received oral instructions explaining the procedure and were told that their descriptions would be recorded and later listened to by a participant in the role of addressee. However, this addressee would not be able to stop the recording or to wind it back. In each of the four tasks, sixteen pictures were placed on the table (see Figure 1). The speakers had to describe the first nine pictures and their order to the hypothetical addressee. The speakers were told that the addressee would see the same sixteen pictures in a random order and would have to choose the nine pictures described by the speaker and to bring them into the target order. (We presented seven pictures in addition to the nine target pictures to ensure that the difficulty of describing the pictures still existed for the 9^{th} position instead of saying “the remaining one is on position 9”). The participants were asked to follow a given order of description: to start with the picture in position 1, continue with the picture in position 2, position 3, and so on.

To emphasize the relevance of the picture-sorting task, the task was framed as resembling real-world settings of collaborative work and a real situation was described as an example. Yet, the participants were aware that they would not be able to interact with an addressee but that their descriptions would be recorded. Depending on the condition, the participants were given different instructions. Participants in the *supporting and without instruction conditions* heard this example: “Please picture the following scenario: An airplane mechanic repairing an aircraft engine is communicating via audio-link with a co-worker in the cockpit. The co-worker is watching the displays to check whether the machines are working properly again. In such a situation, communication errors can lead to fatal consequences." The instructions emphasized the importance of clear and precise descriptions for a successful collaboration, as the second person would have to rely on the descriptions to put the pictures in the target order.

In addition, participants receiving *supporting instructions* were told how to structure the problem-solving and communication process efficiently: First, they had to find the relevant differences between the pictures and to mark them on an additional picture. Only after finishing the search should they start with the description of the first picture. This structure corresponds to a definition of separated individual and collaborative work phases, a measure found to be beneficial for a good collaboration (Hermann, Rummel, & Spada, 2001; Rummel & Spada, 2005).

Participants receiving *hindering instructions* listened to this real-world example: "Please picture the following scenario: An aviator of a passenger plane is communicating with an air traffic controller. Their communication has to take place within a very short period of time, as the captain often has to make very quick decisions based on the information he receives. The task you will be working on should simulate this work under time pressure." This instruction emphasized the importance of working quickly and aimed at producing time pressure for the participants. Table 2 gives an overview of the instruction conditions.

Insert Table 2 about here

Depending on the condition, the participants received either four sets of pictures with low cognitive demands or four sets of pictures with high cognitive demands. The amount of cognitive demands was realized through the salience of the differences: For each picture content there were two different sets of pictures (see Figure 2): In sets with low cognitive demands, the feature differences between the pictures were larger and easier to detect. In contrast, in sets with high cognitive demands, the feature differences were more difficult to detect. For each set of pictures, there were four relevant features with two possible values each (e.g. “window is present” vs. “window is absent” are the two possible values of the feature “presence of the window” in Figure 2, content 1, set 1).

After completing a training task, the participants had to describe four sets of pictures but in different sequences. To control for sequence effects, four different task sequences were given. As an ANOVA revealed no effect of the task order, this factor was not taken into account in further analyses. The four picture contents varied regarding the communicative demands (see Figure 2): Two contents were more difficult to describe (high communicative demands) with abstract, unfamiliar objects (contents 2 and 4), whereas the other two contents showed more concrete, familiar objects (low communicative demands; contents 1 and 3). The difficulty of the tasks (high vs. low communicative demands) was derived from theoretical assumptions. A pretest confirmed the assumed difficulties.

Insert Figure 2 about here

Measures

We used the audio recordings of the speakers’ utterances to examine the quality of the speaker’s description. We counted the *number of irrelevant features* mentioned as well as the *number of features described with delay* in the description. A delayed description of features occurred if the participant detected a relevant feature only after having described several pictures. In addition, we counted the *number of correctly described pictures* for each set. As it was only possible to identify a picture if all four relevant feature values of a picture were mentioned, a picture description was only regarded as correct if the speaker mentioned all four.

Results

To check if the instruction in the hindrance conditions actually led to the intended time pressure, we conducted an analysis of variance (ANOVA) with the time used for the description of each set of pictures. In the supporting condition, the feature search took place before the speakers started their descriptions. To allow a comparison of the three instruction conditions, we added the time for feature search to the time used for description, leading to the total time used for a set of pictures. The means showed the expected tendencies with the mean time used for a set of pictures being lowest in hindrance conditions (mean hindrance = 484 sec; mean control = 561 sec; mean support = 582 sec), but there was no significant difference between the three groups.

We conducted a multivariate analysis of variance (MANOVA) with repeated measures (for the factor communicative demands) in order to test the influence of the three factors (type of instructions, cognitive demands, communicative demands) on the number of irrelevant features, the number of features described with delay, and the number of correctly described pictures. We found an effect of the type of instructions ($F[6, 80] = 3.9$, $p < .01$, $\eta^2 = .2$), an effect of the cognitive demands ($F[3, 40] = 2.4$, $p < .05$, $\eta^2 = .15$), and an effect of the communicative demands ($F[3, 40] = 6.3$, $p < .01$, $\eta^2 = .32$). There were no significant interactions.

Table 3 contains means and standard deviations for all conditions, with each column corresponding to one dependent measure. The results of the calculation of ANOVAs for all dependent measures will be reported separately for each factor.

Insert Table 3 about here

Type of Instruction

There were significant effects of the type of instructions on *the number of irrelevant features* ($F[2, 42] = 4.7$, $p < .05$, $\eta^2 = .18$) and *the number of features described with delay* ($F[2, 42] = 6.3$, $p < .01$, $\eta^2 = .23$). Participants with supporting instructions mentioned significantly fewer irrelevant features than participants without additional instructions (contrast: $F[2, 42] = 4.7$, $p < .01$, $\eta^2 = .18$) and also described significantly fewer features with delay compared to participants without additional instructions (contrast: $F[2, 42] = 6.3$, $p < .01$, $\eta^2 = .23$). Interestingly, the mean number of irrelevant features was higher but the mean number of features described with delay was lower in the condition without additional instruction compared to the condition with time pressure (see Table 3).

Regarding the *number of correctly described pictures*, there was no significant effect of the type of instruction.

Cognitive Demands

For the factor cognitive demands there were no significant effects on *the number of irrelevant features* but there was a small significant effect on *the number of features described with delay* ($F[1, 42] = 3.8$, $p < .05$, $\eta^2 = .08$). As expected, the participants performed better (less delayed features) if the cognitive demands were low. Although there was no significant difference in the mean number of correctly described pictures, there was a tendency in the expected direction (see Table 3).

Communicative Demands

There was a significant effect of the communicative demands on *the number of irrelevant features* ($F[1, 42] = 5.8$, $p < .05$, $\eta^2 = .12$) and the number of correctly described pictures ($F[1, 42] = 13.3$, $p < .01$, $\eta^2 = .24$). As expected, participants performed better with low communicative demands (more correctly described pictures), although the quality of the description was inferior (more irrelevant features described).

Specific Characteristics of Picture Content 4

As described above, the picture contents were meant to vary according to the communicative demands: two contents should be easier to describe (low communicative demands) while two contents should be more difficult (high communicative demands). Picture content 4 has high communicative demands, and the outcome measures should be comparable to those of content 2. However, content 4 did not show the expected characteristics (see Figure 3): Content 4 was too easy. The mean number of correctly described pictures of content 4 is more comparable to that of the contents with low communicative demands.

Insert Figure 3 about here.

Analysis of Communication Errors in Picture Content 4. The divergence in the outcome variable for the two picture contents with higher communicative demands may be due to different realizations of difficulty. In content 2, the greater amount of communicative demands was realized through a pattern of very similar geometrical objects that hindered the description of a feature's location. In content 4, it was realized through the need to determine the frame of reference (viewer-centered or object-centered) for the description of the direction of gaze as well as to specify the manner of describing the watch (focus on the figures or on the watch hand). Both are potential sources for communication problems, as the persons communicating have to be aware of the ambiguities and to define one mutual way of describing the pictures. A clear definition of perspectives is particularly crucial in communication settings where the addressee is not present or not able to interact.

To examine the effects of our supporting and hindering instructions on potential communication errors, we counted the number of correctly described pictures in content 4 regarding (1) the frame of reference used for the direction of gaze and (2) the manner of describing the watch. Depending on the type of instructions, different patterns could be found in the descriptions regarding the frame of reference: In the supporting and without instruction conditions, the speakers either realized the need to specify the frame of reference and described all ($N = 28$ out of 32) of the pictures correctly, or they did not realize this and described none ($N = 4$ out of 32) of the pictures correctly. In contrast, many speakers with hindering instructions ($N = 6$ out of 16) seemed to have realized the necessity of specifying their frame of reference but described only some of the pictures correctly while others were described ambiguously.

Discussion

We aimed to test the impact of supporting and hindering instructions on the quality of the speakers' utterances as one part of knowledge communication. As expected, the supporting instructions enhanced the knowledge communication process with fewer irrelevant features and fewer features described with delay. Indeed, the collaboration script did help to provide a focus on the relevant features and to smooth knowledge communication. However, there was no significant improvement in the number of correctly described pictures. Nevertheless, the mean number of correctly described pictures showed a tendency in the expected direction, with slightly more pictures described correctly in supporting conditions. As there were only four differences to be detected and described in each set of pictures, the advantage of the supporting condition was not very pronounced. In more complex tasks, with more aspects to be taken into account, this script would probably have a greater effect on the outcome.

The implementation of the hindrance condition was realized by using the analogy of an aviator – air traffic controller interaction and emphasizing the importance of working quickly. As a manipulation check we inspected the total time used for the task in the three instruction conditions. Although on a descriptive level the mean time was shortest in the hindrance conditions, there was no significant difference. Were the instructions not ample to produce time pressure? Regarding the measures for the quality of the speaker's utterances, an effect of time pressure could be found: The hindering instructions led to fewer irrelevant features compared to the control condition and more features described with delay. This may allow the conclusion that the hindrance instruction did produce time pressure albeit not in a very strong way. However, the experienced time pressure did have one positive effect: it reduced the inefficient utterances, but participants also neglected relevant features. Still, effects of time pressure probably would have been more pronounced with an instruction producing a higher amount of stress.

In our setting, grounding was not possible because the speaker could not receive feedback from the addressee and was unable to check, if the descriptions were understood. Therefore, taking on the addressee's perspective would have been a good mean to assure mutual understanding. Keysar and colleagues (Horton & Keysar, 1996; Keysar, 1994) were able to show that speakers only take the addressee's perspective or level of knowledge into account as part of a correction mechanism, rather than designing utterances according to the addressee's perspective from the very beginning (monitoring-and-adjustment model). This correction mechanism fails under time pressure, when speakers do not have enough time and resources left to monitor and correct their utterances (Horton & Keysar, 1996; Keysar, 1998). In line with these findings, time pressure influenced the design of utterances also in our study: As in the other conditions, most participants in the hindering conditions seemed to have realized the need to ensure referential identity for their frame of reference. However, the descriptions of some pictures were correct, while others were ambiguous. It can be concluded that the experienced time pressure made it difficult for the speakers to consider the addressee's perspective.

We implemented two dimensions of difficulty: the amount of cognitive and communicative demands. For both dimensions, we found the expected effects on the design of the speakers' utterances, albeit the tasks with high cognitive demands could have been even more difficult: In conditions with low cognitive demands there were fewer features described with delay but no significant difference in the number of correctly placed pictures, and in conditions with low communicative demands more pictures were described correctly. However, low communicative demands led to more irrelevant features. As it was easy to describe the pictures with concrete, familiar objects, the speakers did not avoid this additional effort.

It can be concluded that an increase in the cognitive demands of a collaborative task leads to a decrease in the quality of knowledge communication. This is likely to occur in situations where one collaborator has to fulfill difficult or consuming individual activities. An increase in the communicative demands will have the same detrimental effects: Without enough common ground, mutual understanding, and a mutual frame of reference, knowledge communication and outcome are impaired. This can occur in collaborative tasks with unshared knowledge or ill-defined concepts. Fortunately, the use of supporting instructions in the form of a collaboration script can help to overcome these difficulties in knowledge communication and may enhance effective knowledge communication in collaboration with unshared knowledge or in mentoring tasks.

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Table 1

Design of the study.

		Cognitive demands	
		Low	High
Type of instruction	Supporting	Communicative demands low/ high	Communicative demands low/ high
	Hindering	Communicative demands low/ high	Communicative demands low/ high
	Control	Communicative demands low/ high	Communicative demands low/ high

Note: The type of instruction and the amount of cognitive demands were varied as between-subject factors; the amount of communicative demands as within-subject factor.

Table 2.

The types of instructions.

	Control (Without)	Supporting instruction	Hindering instruction
Example real-world scenario	Airplane mechanic and co-worker	Airplane mechanic and co-worker	Aviator and air traffic controller
Instruction	-	Script to structure the task into a search and a description phase	Time pressure

Table 3.

Means and standard deviations (in parentheses) of the dependent variables for all conditions.

		Dependent variable		
		Irrelevant features	Delayed features	N of correct pics.
Type of instruction	Support	.9 (2.0)	.2 (.6)	6.4 (3)
	Hindrance	5.8 (7.9)	1.5 (1.8)	5.4 (3.1)
	Control	7.8 (9.0)	.9 (1.5)	6.1 (2.9)
		*	**	*ns*
Cognitive demands	High	5.0 (8.6)	1.2 (1.9)	5.3 (3.1)
	Low	4.6 (6.3)	.6 (1.0)	6.5 (2.6)
		ns	*	*ns*
Communicative demands	High	3.6 (6.1)	.8 (1.5)	5.1 (3.1)
	Low	6.0 (8.9)	.9 (1.5)	6.7 (2.9)
		*	*ns*	**

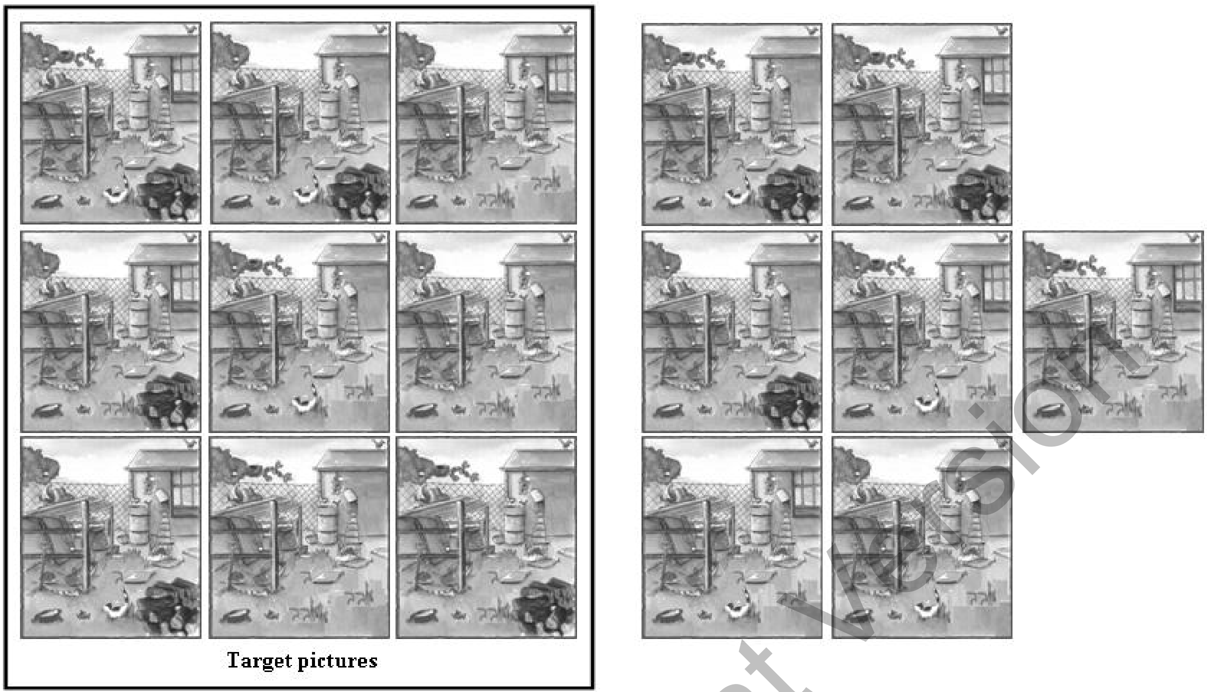
Note. ** $p < .01$; * $p < .05$; *ns* no significant effect.

Figure Caption

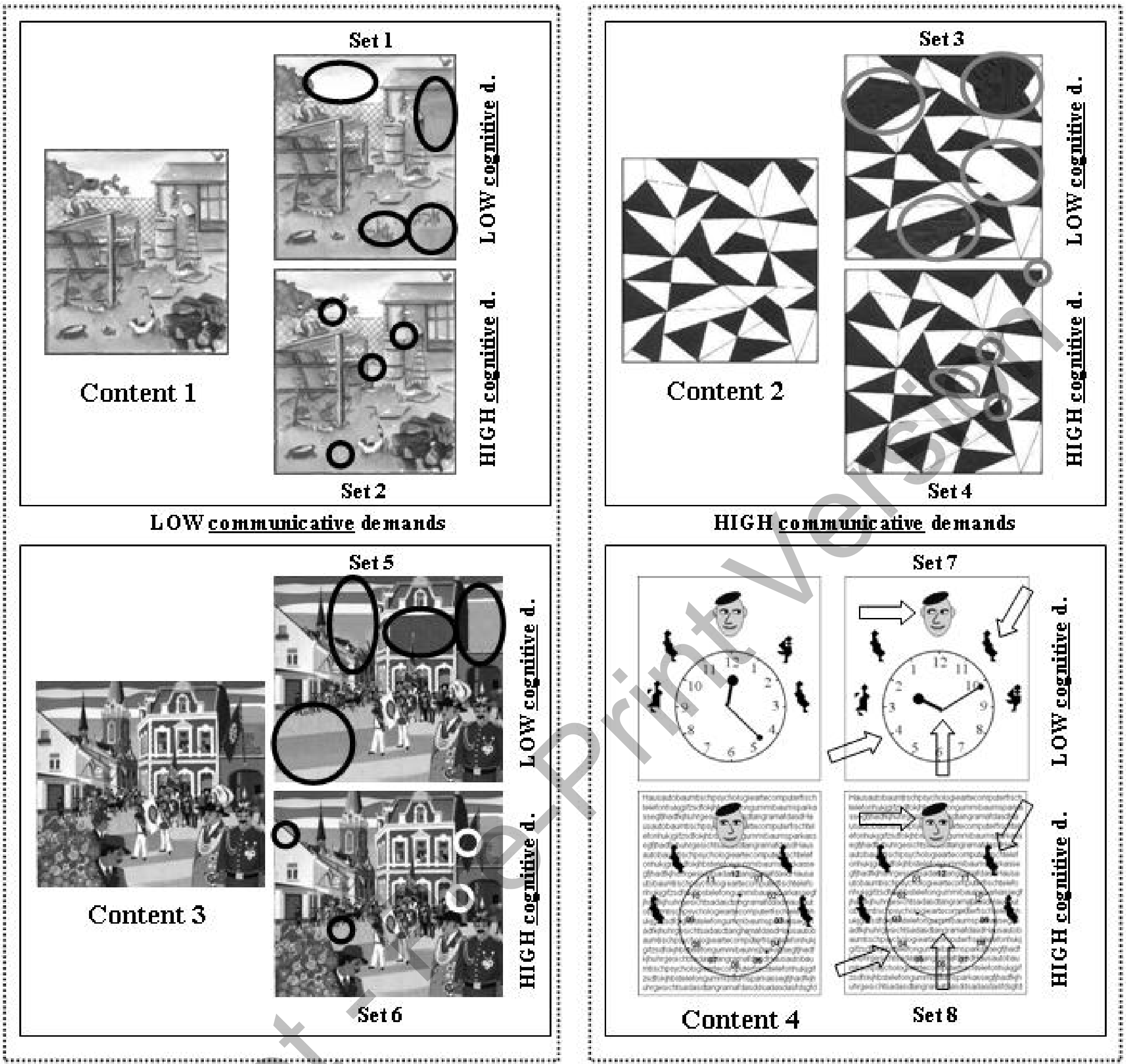
Figure 1. One set of pictures presented to the speaker, consisting of nine target pictures (left) and seven additional pictures (right).

Figure 2. The four picture contents leading to eight sets of pictures.

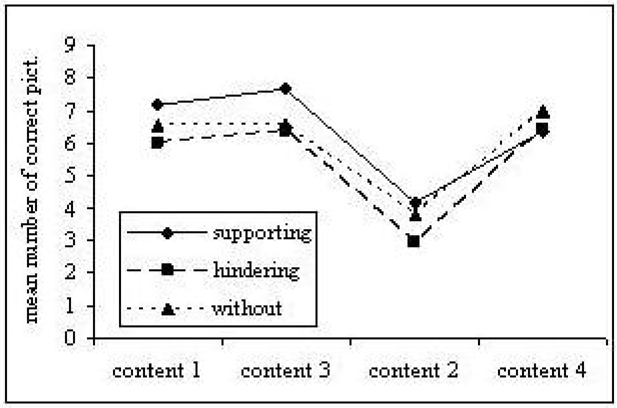
Figure 3. The mean number of correctly described pictures for the four picture contents.



Note: Set of pictures with low cognitive and low communicative demands.



Note: Circles and arrows indicate features that differ between the pictures.



Note. Low communicative demands in contents 1 and 3, high communicative demands in contents 2 and 4.